Field Pilot Study of In-Situ Capping of Palos Verdes Shelf Contaminated Sediments- Operations and Monitoring Plan

Background

The U.S. Environmental Protection Agency (EPA) Region 9 is continuing its investigation regarding the feasibility of in-situ capping all or a portion of the dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyl hydrocarbons (PCB) contaminated sediments on the Palos Verdes (PV) shelf off the coast of Los Angeles, California. In-situ capping is defined as the placement of a covering or cap of clean material over the in-situ deposit of contaminated sediment.

The U.S. Army Corps of Engineers (USACE) has performed an evaluation of in-situ capping options for EPA Region 9. The evaluation included prioritizing areas of the PV shelf to be capped, determining appropriate cap designs, developing an equipment selection and operations plan for placement of the cap, developing a monitoring plan to ensure successful cap placement and long term cap effectiveness, and developing preliminary cost estimates. The complete capping options study is published as USACE Waterways Experiment Station report TR-EL-99-2 (http://www.wes.army.mil/el/elpubs/pdf/trel99-2.pdf).

EPA Region 9 has entered into an interagency agreement with the USACE Los Angeles District (LAD) to provide technical support for ongoing needs at the PV Shelf site to include tasks related to Pre-Design Data Collection & Studies. One aspect of the pre-design studies is a field pilot study of cap placement on the shelf. This document serves as the operations and short-term monitoring plan for the field pilot study. A long-term monitoring plan will be developed once pilot capping activities are completed.

Description of In-Situ Capping Options

Two capping approaches were considered in TR EL-99-2 for selected areas of the shelf: 1) placement of a Thin Cap (design thickness of 15 cm) which would isolate the contaminated material from shallow burrowing benthic organisms, providing a reduction in both the surficial sediment concentration and contaminant flux, and 2) placement of an Isolation Cap (design thickness of 45 cm) which would be of sufficient thickness to effectively isolate the majority of benthic organisms from the contaminated sediments, prevent bioaccumulation of contaminants and effectively prevent contaminant flux for the long term.

The shelf area presently under consideration for capping lies between the 40- and 70-m depth contours (in TR EL-99-2, this area was defined as two separate capping prisms: prism A centered over the “hot spot”, and prism B located northwest of the “hot spot"). If capping is selected as a remedy for the PV Shelf, the operations would be done in an incremental fashion until the total selected area was capped. Since the area that is being considered for capping is large (on the order of several square kilometers), capping placement cells 300 by 600 m have been defined for purposes of managing the placement of material and monitoring[1].

Pilot Study Objectives and Approach

The overall objective of the field pilot study is to demonstrate that a cap can be placed on the shelf as intended by the design and to obtain field data on the short-term processes and behavior of the cap as placed.

Specific objectives to be addressed as a part of the pilot include:

1. Demonstrate that an appropriate cap thickness can be placed with an acceptable level of variability in cap thickness.
2. Demonstrate that excessive resuspension of existing sediments and excessive mixing of cap and contaminated sediments can be avoided.
3. Demonstrate that excessive losses of cap materials can be avoided.
4. Determine, to the degree possible, the effect of variable cap material type, bottom slope, water depth, and placement method (e.g., conventional versus spreading) on cap thickness and sediment displacement and resuspension.
5. Demonstrate the effectiveness of the cap with respect to short-term isolation of contaminants during the initial advective flow resulting from sediment consolidation.
6. Demonstrate the ability to monitor operations and success.
7. Evaluate and modify, where needed, all operational and monitoring approaches.
8. Improve the knowledge base contributing to decisions on implementation of a full scale cap.

The construction of the field pilot study cap is anticipated to occur over a time period of several weeks, and the associated monitoring effort will focus on short term processes associated with cap construction. The pilot study would therefore meet several objectives related to capping operations and processes occurring during and shortly after cap material placement. A full-scale monitoring program to be conducted during any placement of a full-scale cap and in the years to follow would additionally include activities aimed at long-term processes which could not be easily observed during the time period available for a pilot study (e.g. erosion during storm events or migration of contaminants due to diffusive processes). Depending on the time scales in which the pilot cap is left in place prior to any full scale cap placement, there may be opportunity to obtain data from the pilot area related to such long-term processes, but such activities are not included in the present pilot scope.

The pilot study approach consists of controlled operations for placement of capping material within selected areas on the PV shelf and associated monitoring prior to, during, and following the placements. Operational aspects for the pilot include the selection of appropriate placement areas for the pilot, capping materials, and placement techniques. Monitoring aspects for the pilot include cap thickness as placed, mixing of cap and contaminated sediments, resuspension of contaminated sediments during cap placement, short term cap benthic recolonization, and short term physical and chemical characteristics of the cap and underlying sediments immediately after capping and following initial sediment consolidation.

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1 It should be noted that a grid of 56 capping placement cell locations was defined in TR EL-99-2 for purposes of volume and cost estimates for various capping options, however, these cell locations are not considered "cast in concrete" for purposes of either the pilot or any full scale capping operation. A new grid has been defined for purposes of the pilot with cells as shown in Figure 1 .

The remainder of this Operations and Monitoring Plan is divided into the following sections:

- Selection of Pilot Capping Placement Areas
- Selection of Cap Material Sources
- Placement Equipment and Contract Arrangements
- Pilot Cap Thickness and Volume
- Refined Model Predictions
- Sequence of Placement Operations
- GIS-Based Project Management Tools
- Monitoring Requirements
- Reports and Interpretation
- References
- Appendix A - Monitoring Scope of Work

Selection of Pilot Capping Placement Areas

Specific considerations for selection of the pilot placement locations include:

1. To the extent possible, placement locations for the pilot should be representative of the overall range of conditions within the total anticipated capping prism for a full scale remediation.
2. Different pilot placement locations will be necessary to demonstrate the effect of water depth, bottom slope, cap material type, and placement method on cap thickness and sediment resuspension.
3. Physical bottom material type in the pilot placement areas should be clearly distinguishable from capping material. This requirement would be met by any location with surficial fine-grained effluent-affected (EA)sediment, since the capping material is anticipated to be composed of fine sandy sediment.
4. The thickness of the EA sediment in the pilot placement areas should be greater than the maximum depth of EA sediment resuspension that will occur during placement. The thickness must also be sufficient to measure the effects of advection due to consolidation. The mixing thickness requirement with respect to resuspension would be met with any location with surficial fine-grained EA sediment thickness in excess of 10 cm. The thicker the EA deposit, the easier the measurement of advection effects.
5. The level of surficial EA sediment contamination (upper few cm) for the pilot placement areas will affect whether water column measurements of contaminants (DDT and/or PCBs) can be used to evaluate resuspension and transport. Areas with lower ranges of surficial contamination (i.e. a few mg/kg DDT) have low potential for water column release. Areas with higher ranges of surficial contamination (i.e. 10 to 20 mg/kg DDT) would provide conservative (worst-case) data on resuspension and water column release.
6. There are concerns related to placement of capping materials directly over or immediately adjacent to the LACSD outfall pipes. Until the nature of cap accumulation is demonstrated, cap placements should NOT be located directly over or immediately adjacent to LACSD outfall pipes.
7. Recontamination of the pilot cap during cap placement may complicate the interpretation of pilot study results, and if such recontamination occurs following

placement (e.g., due to transport of contaminated sediments from uncapped areas "upcurrent " of the pilot cap), the area may have to be capped a second time if EPA decides to proceed with a full-scale capping remedy. The potential for such recontamination will vary depending on pilot cell locations (among other things). The prevailing bottom current is from southeast to northwest, so locations to the southeast are preferable from this standpoint.

8. The southeastern boundary of capping Prism A as defined in TR EL-99-2 is currently based on the EA sediment footprint as defined by the 1994 USGS box core data. LACSD data indicate that EA sediment extends well to the southeast of this boundary, although thickness and contaminant concentrations decrease as well. This area is not well characterized in terms of sediment core data. Additional data would be needed to further define the most appropriate boundary which should be considered for capping, including any decision to locate the pilot capping cells in this area.
9. The size of the pilot capping area(s) should be sufficiently large to avoid interference between intentionally separate placements (using different placement methods and/or cap materials) and to allow for demonstrating the effect of multiple placements in building the desired cap thickness. Modeling results indicate the size of a footprint of measurable cap thickness accumulation resulting from a single conventional placement is about the size of a single 300 by 600 meter capping cell. Therefore a buffer of approximately 300 to 600 m between capping cells and/or separate placements should be sufficient to avoid interference between intentionally separate placement events (whether they are single hopper loads or multiple loads within a cell). Also, multiple placements within a single capping cell would result in deposits sufficiently large to observe the buildup effect.

Based on the above considerations, four 300 by 600 meter capping placement cells were recommended for the pilot. One pair of cells would be located adjacent to the landward limit of the capping area in a comparatively shallow site with comparatively flat bottom slope (40 m to 45m depth contour with an average slope across the cell of about 1.5 degrees). A second cell pair would be located adjacent to the seaward limit in a comparatively deeper site with steeper bottom slope (60 to 70 m depth contour with average slope across the cell of about 2 degrees). The two cells within each pair would be separated by a full cell length in the along-shore direction and by a full cell width in the perpendicular direction to avoid the potential for interferences during monitoring.

No single area within the identified capping prisms is ideal with respect to all the considerations listed, therefore two potential locales with differing conditions were identified and compared in selecting the pilot cell locations. One locale evaluated for the placement cells is at the southeastern end of capping prism A, in the area roughly bounded by the 40 and 70 m depth contours and between LACSD transects 9 and 10. This area is to the southeast of the terminus of the outfalls, on the "upcurrent" end of the capping area with respect to prevailing bottom currents. There is little USGS boxcore data for this area, however, available LACSD data indicates the EA sediment thickness in this area easily exceeds 10 cm (refer to Figure 60 in Lee et al 1994) and the surficial dichlorodiphenyldichlorothene (DDE) concentration is about 2 mg/kg (refer to Figure 5 in Lee et al 1994). This locale has the advantage of "upstream" location with respect to residual bottom currents, but has the disadvantage of thin EA sediment thickness and low DDE concentration with respect to the overall area.

A second locale evaluated for pilot placement is to the northwest of the terminus of the outfalls. There is good USGS boxcore data coverage for this area. The EA sediment thickness in this area is in excess of 50 cm (refer to Figure 60 in Lee et al 1994) and the surficial DDE concentration is 10 to 20 mg/kg (refer to Figure 5 in Lee et al 1994). This locale has the disadvantage of being "downstream" of a significant portion of the site with respect to bottom currents, with a higher potential for surface recontamination. But the sediment thickness is greater, with easier interpretation of consolidation effects, and the surficial DDE is high, yielding better resolution potential for cores and worst-case resuspension data. This locale is also "downstream□ with respect to the outfalls, thus minimizing the possibility for interference with outfall operations.

In evaluating and comparing these two locales, the potential disadvantages of recontamination during placement for the northwest locale were deemed acceptable, and this locale was therefore selected for the pilot placements. The four cell locations recommended in this locale are labeled LU (Landward Upcurrent) at cell location G3 in Figure 1, LD (Landward Downcurrent) at cell location I3, SU (Seaward Upcurrent) at cell location G1, and SD (Seaward Downcurrent) at cell location I1. The cell grid in Figure 1 may be adjusted following the collection of baseline data as described below. Pilot placements would occur within the limits of these cells, but the area monitored would extend to adjacent cells. As described below, the present pilot scope calls for use of three of the four selected cells for the pilot placements.

Selection of Cap Material Sources

LAD surveyed the region for potential cap material sources as a part of the capping options study and is currently updating available information on borrow sources. Dredged sediments from navigation channels (primarily the Queen's Gate deepening project) and sand borrow areas were identified as the two primary sources, and the cap designs and placement approaches were developed based on those potential sources. LAD conducted additional exploration of both the Queen's Gate and Borrow Areas for this study. Data for these sources indicate that the materials are variable and are mixtures of fine sands, silts and clays.

The cap material used for the pilot study must be representative of the materials which would be available for a full scale capping remedy. Other drivers in selection of pilot capping materials are cost and schedule. Use of dredged material from on-going navigation projects will be far less expensive than excavation from borrow sites, since the operational cost attributable to the pilot would be limited to the difference in transportation and disposal cost to the PV shelf as compared to the selected disposal sites. But use of dredged material from the on-going project is dependent on close coordination of navigation dredging schedules and contracts. Use of dredged material from an approved navigation project can also be advantageous for the overall schedule, since the dredging impacts in the channel areas and ocean disposal of the sediments will have already been evaluated, thus making the National Environmental Policy Act (NEPA) process and other regulatory considerations for the pilot project more straight-forward.

The Queen's Gate project is the only on-going navigation project identified to date with sufficient volumes of clean material to conduct the pilot project described in this plan. The material has an in-situ mean grain size of approximately 0.1 mm. Recent sampling has indicated that there may be localized areas with coarser mean grain size. Also, dredging operations for Queen's Gate and any subsequent placement of the materials in rehandling sites such as the West Anchorage site, results in some losses of fines during overflow and placement, with a subsequent "coarsening" of the material. Modeling to date indicates that the Queen's Gate material can be used for cap construction if the conventional method of placement is used. LAD has indicated that the finer material mixtures from Queen's Gate may be representative of much of the material available from the borrow areas. Therefore, in the context of the pilot, use of Queen's Gate is appropriate for demonstration of conventional placement techniques with a finer material type available in the Los Angeles region. LAD has taken additional borings in selected areas within and adjacent to the present navigation project to locate coarser grained materials for demonstration of spreading placement techniques with a coarser material type.

Sand borrow areas outside the harbor breakwaters (designated as AII and AIII) have in-situ mean grain sizes in excess of 0.2 mm. However, these materials are also highly variable, and there are environmentally sensitive areas located within the larger borrow areas corresponding to submerged aquatic vegetation (SAV) and rock "pinnacles" with high fisheries values. LAD has obtained borings in selected portions of borrow areas AII and AIII (water depths less than 80 ft and outside known sensitive areas) and identified a source of coarser material for the pilot.

Modeling conducted to date indicates that use of mixtures of fine sand and silt/clay cap material (such as material from Queen's Gate) results in a larger proportional dispersion off-site, and potentially greater spread downslope as compared to a coarser sand (such as from the sand borrow areas). The finer materials will initially be placed using conventional release from the hopper dredge. The coarser materials will initially be placed using a spreading method of placement.

Placement Equipment and Contract Arrangements

Hopper dredges were identified as a preferable placement equipment type in TR EL-99-2, and use of a hopper dredge is planned for the pilot. A hopper dredge is the equipment of choice for the pilot capping on the PV shelf for the following reasons:

a. Hopper dredges are currently the most readily available equipment for the pilot work.
b. Hopper dredges provide better control of placement in the open ocean environment and allow for more flexibility in placement options to include pumpout capabilities.
c. Hopper dredges remove material from channels by hydraulic means, resulting in a breakdown of any hardpacked material and addition of water as material is stored in the hopper for transport. Material from hopper dredges is therefore more easily dispersed in the water column, and would therefore settle to the seafloor with less energy and less potential for resuspension of the contaminated sediment.

Current plans call for use of the NATCO Manhattan-class dredge *Sugar Island* for the pilot placements. The *Sugar Island* utilizes a split-hull hopper opening mechanism that can be used to control the rate of release. This dredge is also equipped with a hopper pumpout capability over the bow and water jets to aid in pumpout operations. Pumpout can also be accomplished through the adjustable skimmers within the hopper. NATCO has indicated that, with minor modifications, pumpout can be accomplished through one of the two dragarms, allowing for a submerged point of discharge. Any of these methods of placement could potentially be utilized during the pilot.

Pilot Cap Thickness and Volume

Two objectives of the pilot are drivers in determining the volumes of material necessary for placement for the pilot: 1) the need to determine differences in cap material behavior for differing placement options, and 2) the need to determine the volume of material required to construct a full design cap thickness over a given area. Time and cost limitations for the pilot make it impractical to undertake construction of the full design thickness for each possible combination of cap material type, water depth, bottom slope, and placement technique. The pilot study activities were therefore scoped to ensure that the effort remained within budget. This process continued during the planning and design of the pilot study and as firm cost estimates for pilot cap placement and monitoring were developed. In considering the final scope of activities, both reductions in the level of monitoring effort and reductions in the total volumes of material placed by location or by method were considered.

The pilot will include a combination of small placement volumes and larger placed volumes. Data on various placement methods and variable material types can be obtained from a few hopper placements with small placement volumes. The most likely placement method and material type to be employed full scale should be evaluated for construction of a full cap design thickness over a sufficient area to determine the process of cap thickness buildup for adjacent placements. Since the bottom slope only slightly increases with water depth for areas between the 40 and 70 meter depth contours, a comparison of shallow and deeper placement areas for the pilot would provide the needed information for both depth and to some degree, bottom slope.

These considerations guided the pilot scoping process and the final selection of the following pilot placements:

Fine material/ conventional placement/ shallow cell/ large placement volume
Coarse material/ spreading placement/ shallow cell/ small placement volume
Fine material/ conventional placement/ deep cell/ small placement volume

Small Volume Pilot Placements

Placement of a relatively small volume should be sufficient to observe the differences between conventional versus spreading placement methods, finer versus coarser material types (cap material sources) and shallow versus deeper cells. Based on the modeling conducted to date, the spreading method of placement is appropriate for the coarser material type. Placement of coarser material using conventional methods is not considered desirable, at least for the initial layer of cap material, because of the higher potential for sediment displacement and resuspension.

Removal of large volumes from the sand borrow area may require extensive and time-consuming studies. Large volumes of coarse material have not be identified within the scope of the current Queen's Gate project. For these reasons, placement of coarser material for a full cap thickness over a large area is not anticipated for the pilot, and the placement of coarse material will be evaluated with small volume placements. The small volume placements should be at least a few hopper loads (say five to ten hopper loads) to confirm the rate of buildup of cap thickness and spreading and dispersion behavior. Small volume placements using spreading were originally planned for both cells LD and SD, but placements in SD were eliminated in the pilot scoping process. Data for comparison of spreading methods in shallow versus deep cell placements will therefore not be collected, but the placements in cell LD and LU will allow for comparison of spreading methods versus conventional placements, considered more critical in meeting the overall pilot study objectives.

The anticipated hopper load from the sand borrow area for a Manhattan class dredge is approximately 1400 cubic meters (hopper or "bin" volume)[2]. Coarse cap material should be placed using spreading methods only, and ideally would be placed in both shallow and deep cells. Such multiple small volume placements would require on the order of 20,000 cubic meters (in hopper volume) from a coarse grained site.

Small volume placements (approximately 10 hopper loads) will also be used to determine the behavior of Queen's Gate material placed at the deeper depth in cell SU using conventional placement methods. These placements would be located at approximately the center of the cell between the 62 and 65 meter depth contour. Large volume placement was originally planned for cell SU, but the volume of placement was reduced in the pilot scoping process. Data on volumes required for full scale cap construction in a deeper cell to include the portion of the cell near the shelf break will therefore not be collected, but the small volume placement will provide data on the rate of buildup of cap thickness and spreading and dispersion behavior for the deeper cell versus the shallow cell using conventional placement methods.

Full Design Cap Placements

Designs of 15 cm for a thin cap and 45 cm for an isolation cap were recommended in TR EL-99-2. Sufficient material should therefore be placed during the pilot to determine if these cap thicknesses can be constructed over a larger area with acceptable rates of buildup and acceptable variability in cap thickness, considering the overlapping effect of adjacent placements. The major consideration here is to observe the rate of sediment accumulation as a function of distance from clusters of individual hopper dredge placements. It may not be necessary to construct a full 45 cm cap thickness to obtain the needed field data on full design cap placement. If a 15 cm cap can be constructed over a larger area, then the same methods of placement can be used to construct a 45 cm cap.

Data on placement behavior for the full design cap thickness are desirable for both shallow and deep pilot cap placement areas. However, available resources will only allow for placement of a full 15 cm cap thickness over one full cell. The source of fine grained cap material will be Queen's Gate and this material source would be used to build the design cap thickness in the shallow upstream cell. A 15 cm coverage over one 300 by 600 m cap cell equates to 27000 cubic meters in-cap volume. To accumulate this thicknesses uniformly over a total cell, a larger volume must be placed, with some of that material going onto adjacent cells and some being lost during placement. Recent experience with the Queen's Gate project indicates the in-hopper settled volumes are roughly equivalent to the in-source volumes, and the typical hopper load is 925 cubic meters (in-source volume). Approximately 42000 cubic meters in-source volume (approximately 47 hopper loads) would be needed to construct a 15 cm cap over one cell

Refined Model Predictions

The USACE MDFATE model was used to predict the rate of cap material buildup for specific sediment characteristics, various water depths over the shelf and various placement approaches. The USACE STFATE and SURGE models were used to predict cap material dispersion during placement and evaluate the velocities of bottom impact on spreading behavior, respectively. These predictions were based on a broad range of assumed properties for the cap material. Once specific cap material sources are selected, refined predictions using the specific site conditions and cap material properties should be made. Results of the refined predictions will determine

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[2] Personnal communication with Bill Pagendarm, NATCO.

any needed adjustments in the operational approach and monitoring station placement for the initial placements for the pilot. The models will also be used during the course of the pilot placements to refine operational methods for full cap placements constructed as a part of the pilot.

Sequence of Placement Operations

A sequence of the pilot placements must consider the need to observe the basic behavior of single hopper dredge placements for finer versus coarser cap material, seaward versus shoreward cell locations, and spreading versus conventional placement methods. In this way, if the behavior of a given placement exceeds acceptable limits on spread or dispersion or resuspension, adjustments can be made to the operation prior to placement of larger volumes over a larger area during the pilot.

The proposed Placement/ Monitoring sequence is summarized in Table 1 and is described as follows:

> **Event #0: Verifying Release Rates** - Prior to any actual pilot placement on the site, releases of the Queen's Gate material with conventional placement methods at the disposal sites now in use should be observed to determine the nature and rate of release from the hopper. Placements of coarser material with the spreading method of placement should also be observed at the disposal sites now in use to determine the rate of release from the hopper and any tendency of the material to bridge. These can be considered "practice releases" for purposes of the pilot and must be conducted outside the potential capping prism.
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> **Event #1: Single Conventional Discharge in Cell LU** - The first pilot placement would be a single hopper load of the finer material from Queen's Gate discharged at the center of cell LU (see Figure 1). This load would be placed using the conventional placement method. Approximately one week of downtime following this single placement should be planned to assess the adequacy of the monitoring equipment and techniques, shift instrumentation for the next placement, and analyze the monitoring results for this single placement. This single hopper load would be followed later (in Event #3) by a full 15 cm cap over cell LU.
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> **Event #2: Single Spreading Discharge in Cell LD** - This event would be a single hopper load discharged along the centerline of cell LD using coarse material from the AIII borrow source (see Figure 1). A single load would be placed using a spreading method of placement. The direction of travel of the hopper should be in a direction away from the outfalls to allow for any overshoot of the placement away from the outfalls. Once the data from a single hopper placement have been assessed, placement of up to 10 additional hopper/barge loads will occur later (as part of Event #3), with the intent of creating a thicker cap using this method. Once it has been determined that data collection is complete for Event #2, (i.e. data such as SPC images are captured), Event #3 could proceed from a scheduling standpoint prior to complete initial analysis of data from Event #2.
>
> **Event #3: Full 15 cm Cap Thickness in Cell LU/ Small Volume in Cell LD** - Event #3a is the essentially uninterrupted placement of a full 15 cm cap thickness over cell LU.

Event #3b is the additional spreading of coarse material in cell LD. Event #3 can proceed if the spreading and dispersion observed for the Event #1 single placement is acceptable, and the initial placements for Event #3 would not interfere with Event #4 in the seaward cell SU located downslope from cell LU. The Event #3a would be conducted using conventional placement techniques and finer material from Queen's Gate. Additional hopper placements would be made at the same release point as used for Event #1 until a cap thickness of ~ 15 cm is constructed. Then placement locations would be shifted to the next placement point and the process repeated to build the thickness over a larger area. Spacing between placements of 60 meters is recommended in TR EL-99-2, and this spacing will be refined based on additional modeling. Once placements are completed along the entire landward lane, the placements would be shifted to the next lane. Spacing between lanes would initially be set at 60 meters. Both the lane and placement spacings may be adjusted, during the cap placement, depending upon observed rates of buildup. Event #3b consists of the placement of additional hopper loads of coarser material in cell LD using the spreading method to evaluate the buildup of cap thickness using this method of placement.

Event #4: Single Conventional Discharge in Cell SU- This placement is similar to Event #1 except in a deeper seaward cell. A single hopper load of the finer material from Queen's Gate would be discharged at the center of cell SU which is at the ~60 to 65 m depth. This load would be placed using the conventional placement method. Essentially no dredge downtime would be needed to analyze the monitoring results for this single placement if previous data from Event #1 indicates no interference from on-going cap placement during Event #3. Once it has been determined that data collection is accomplished for this event, and instrumentation is shifted, the next event could begin.

Event #5 : Event #5 (spreading placement in cell SD) has been eliminated from the pilot scope due to resource constraints, but the event numbers were not changed.

Event #6a: Small Volume in Cell SU - Event #6a is the placement of additional hopper loads to create a full 15 cm cap thickness over a portion of cell SU. Event #6b (additional spreading placement in cell SD) has been eliminated from the pilot scope. Event #6a can proceed if the spreading and dispersion observed for the Event #4 single placement is acceptable. Event #6a would be conducted using conventional placement techniques and finer material from Queen's Gate. Initial placements start at the landward boundary of cell SU.

Event #7: Event #7 (constructing a 45 cm cap thickness in cells LU and SU) has been eliminated from the pilot scope, but the event numbers were not changed.

GIS-Based Project Management Tools

Once the placement operations begin, data will be available from side-scan surveys, sediment profile surveys, etc. within hours to a few days. Decisions to continue placement with an initial operational approach or to change the approach must be made in a matter of days throughout the period of the pilot. This will require a reliable and flexible data management tool. GIS-based approaches are proving to be invaluable in such a project environment. Such a system is now in use in management of the Historic Area Remediation Site off New York Harbor. Similar approaches will be developed and used for the PV Shelf pilot project and could be later used for a full scale cap placement.

Monitoring Requirements

Key Questions to be Addressed

Monitoring of the Pilot project will enable the EPA to address five key short and intermediate term questions relative to capping on the Palos Verdes Shelf. These questions are:

- Does placement occur as modeled?
- Can a uniform cap be constructed?
- Can disturbance to in-place sediments be kept within tolerable limits?
- Does the cap remain clean?
- Does the cap remain stable during placement?

Each of these questions (with slight variation in wording) and the generic monitoring approach was addressed in Appendix F of TR EL-99-2, but the environmental concerns that relate to these issues are summarized here. The detailed scope of work to accomplish this monitoring is attached as Appendix A to this document.

<u>Does placement occur as modeled?</u> This question and its associated monitoring will incorporate several concerns that have been raised about the placement of sediments from vessels at the ocean surface onto the seafloor below. These concerns include:

- how far the sediments spread,
- how thick the material is once it comes to rest on the bottom,
- the effect of depth, slope, and material type,
- and the potential for the creation of turbidity flows or mudwaves.

For example, modeling predicts that one hopper load of sediment placed by split-hull methods will produce a deposit approximately 500 meters in diameter with a maximum thickness of 3 cm at the center and thinning to 0.1 cm at the edge.

Several monitoring tools will be used to measure the actual distribution and thickness of the deposit during the Pilot project (Table 2). Combined, these will allow an assessment of how actual field conditions reflect those predicted by the model.

<u>Can a uniform cap be constructed?</u> This question involves the ability to place multiple loads of sediment over an area without exceeding an acceptable range of variation in cap thickness. At issue is how effectively we can adjust parameters under our control (such as placement method or type of cap material) in order to overcome any adverse effects on construction that are a function of things we can't control (such as water depth, EA sediment characteristics or bottom slope). The ability to control placement will be assessed both during the series of hopper placements and once they are complete. Many of the same tools used for the above effort will be utilized in these interim surveys with the addition of sub-bottom profiling.

<u>Can disturbance to in-place sediments be kept within tolerable limits?</u> Sediments released from the placement vessel will fall through the water column, reach the bottom, and then spread

laterally. This process has the potential to disturb the in-place sediments both at the direct point of impact, and to a lesser degree in the area where lateral spread occurs. The Operations Plan is intended to minimize potential disturbance by only disposing directly on the EA sediment with the initial hopper load. Following this first hopper load, the next several will be directed to the same location so that disturbance of the EA sediment will be insulated by the sediments already in place from the first load. From that point on, all subsequent disposal will always occur over cap sediments that have already reached their position on the seafloor through lateral spreading.

The amount of disturbance to the EA sediments will be assessed both at the point of impact and in the area of lateral spreading. The sediment profile camera and coring will be the principal methods used to assess this level of disturbance. In particular, the absence or thickness of the sediment's oxidized layer, which will be measured prior to disposal, will provide a very good marker for this assessment.

A second concern regarding mixing is the effect on water quality. Again, because of the operational approach, resuspension of EA sediment should be greatly reduced after the initial placement, but the amount of contaminant in the plume will be monitored to assess this expectation. This effort will involve tracking the plume and measuring suspended solids and contaminant concentration relative to background.

<u>Does the cap remain clean?</u> In the short and intermediate term this question will be addressed as part of the assessment of mixing of the EA and cap sediments. Both direct coring with chemical analyses and the sediment profile photographs will be useful for evaluating whether the cap was placed with minimal mixing. Some presence of contaminants in the cap can be expected, because of the natural resuspension and transport of EA sediments that will occur during the cap construction process, along with resuspension caused by the operations themselves. However, the monitoring will allow measurement of what levels can be expected immediately after capping. These data will then be useful for determining any changes in the sediment or contaminant profiles in future cores.

<u>Does the cap remain stable during placement?</u> The stability of the cap both during and immediately after construction will be determined by the combination of surveys that are being conducted to assess the distribution of the cap over the EA deposit. The bottom mounted arrays will document the changes in bottom lateral surge speeds that occur during the placement process. Side-scan, sediment profile photography, and coring will all be used to map the actual extent of the deposit. Side-scan in particular, will be useful for assessing the down slope spread of material in assessing the potential for turbidity flow.

Monitoring Program Components

The monitoring program, as detailed in the appendix, consists of several integrated components. The lists below provide a summary of these components, the tools, and the data that will be collected.

Baseline Data Collection

Vane shear strength for in-situ sediments
Side scan sonar
Relative density/ water content of in-situ sediments
Grain size

Chemistry (p,p'-DDE) from cores
Sediment profile camera photographs

Hopper Dredge Operation Data

Transit route
Positioning during placement
Time to release material

Hopper Load Monitoring

Hopper load curves for all loads
Samples of hopper inflow and overflow for GSD, TSS, and TOC
(Samples for each load for small placements; 5% of loads for full cap)

Data Collection During Placement

OBS/ADCP bottom array
Ship deployed OBS/ADCP
Water column samples
Sediment profile camera photographs (for cap buildup and extend of accumulation)
Sediment cores
Side-scan sonar survey

Post Cap Construction Monitoring

Subbottom profiling
Sediment profile camera photographs
Sediment cores

Post Consolidation Monitoring

Subbottom profiling
Sediment profile camera photographs
Sediment cores
Vane shear and relative density

Longer Term Questions

The current monitoring scope that has been developed for the Pilot project does not include far field or long term monitoring, though this scope will be prepared when requested by the EPA project managers. TR EL-99-2 provides the outline for that effort, but briefly, it would include coring, sediment profile camera surveys, and sub-bottom profiles.

Several other items related to long-term cap performance monitoring are not explicitly addressed in this plan. This includes determination of the abundance of deep burrowers, reductions in water column contaminant concentrations, verification of the diffusion model, and reductions in tissue levels in resident benthic or fishery species. If EPA decides to proceed with a full-scale capping remedy, a detailed monitoring program to address long term questions would be included.

Reports and Interpretation

Data reports from the monitoring contractor should be provided as data are collected. A post-cap comprehensive report will be prepared (joint effort USACE/ Contractor).

References

Lee, H.J. 1994. "The Distribution and Character of Contaminated Effluent-Affected Sediment, Palos Verdes Margin, Southern California," Expert Report prepared for National Oceanic and Atmospheric Administration and the U.S. Department of Justice.

Palermo, Michael, Paul Schroeder, Yilda Rivera, Carlos Ruiz, Doug Clarke, Joe Gailani, James Clausner, Mary Hynes, Thomas Fredette, Barbara Tardy, Linda Peyman-Dove, and Anthony Risko. 1999. "Options for In Situ Capping of Palos Verdes Shelf Contaminated Sediments," Technical Report EL-99-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. http://www.wes.army.mil/el/elpubs/pdf/trel-99-2.pdf

USACE Los Angeles District. "Project Management Plan (PMP) For U.S. Environmental Protection Agency, Region IX on Palos Verdes Shelf Superfund Site, Los Angeles County, California," Prepared by U.S. Army Corps of Engineers Los Angeles District.

Table 1. Sequence of Placement Operations

EVENT #	LOCATION	PLACEMENT ACTIVITY
0	off-site	Verifying Release Rates
1	LU	Single Conventional Discharge
2	LD	Single Spreading Discharge
3	LU	Full Cap Thickness - Conventional Discharge
	LD	Small Volume - Spreading Discharge
4	SU	Single Conventional Discharge
5	SD	Single Spreading Discharge
6	SU	Full Cap Thickness - Conventional Discharge
	SD	Small Volume - Spreading Discharge
7	LU/SU	Full 45 cm Cap Thickness

Table 2. Monitoring Tools and Applications

MONITORING TOOL	APPLICATIONS
Sediment Profile Camera	Sediment layer thickness, lateral extent, layer mixing, grain size, biological condition
Coring	Sediment layer thickness, layer mixing, grain size, chemical profile, cap stability
Side-scan sonar	Sediment distribution, bottom disturbance features, bottom topography
Sub-bottom chirp profiler	Cap thickness
Acoustic Doppler Current Profiler (ADCP)	Current speed, surge speed, plume location
Optical Back Scatter	Plume location and relative concentration
Water samples	Suspended solids, contaminant concentrations

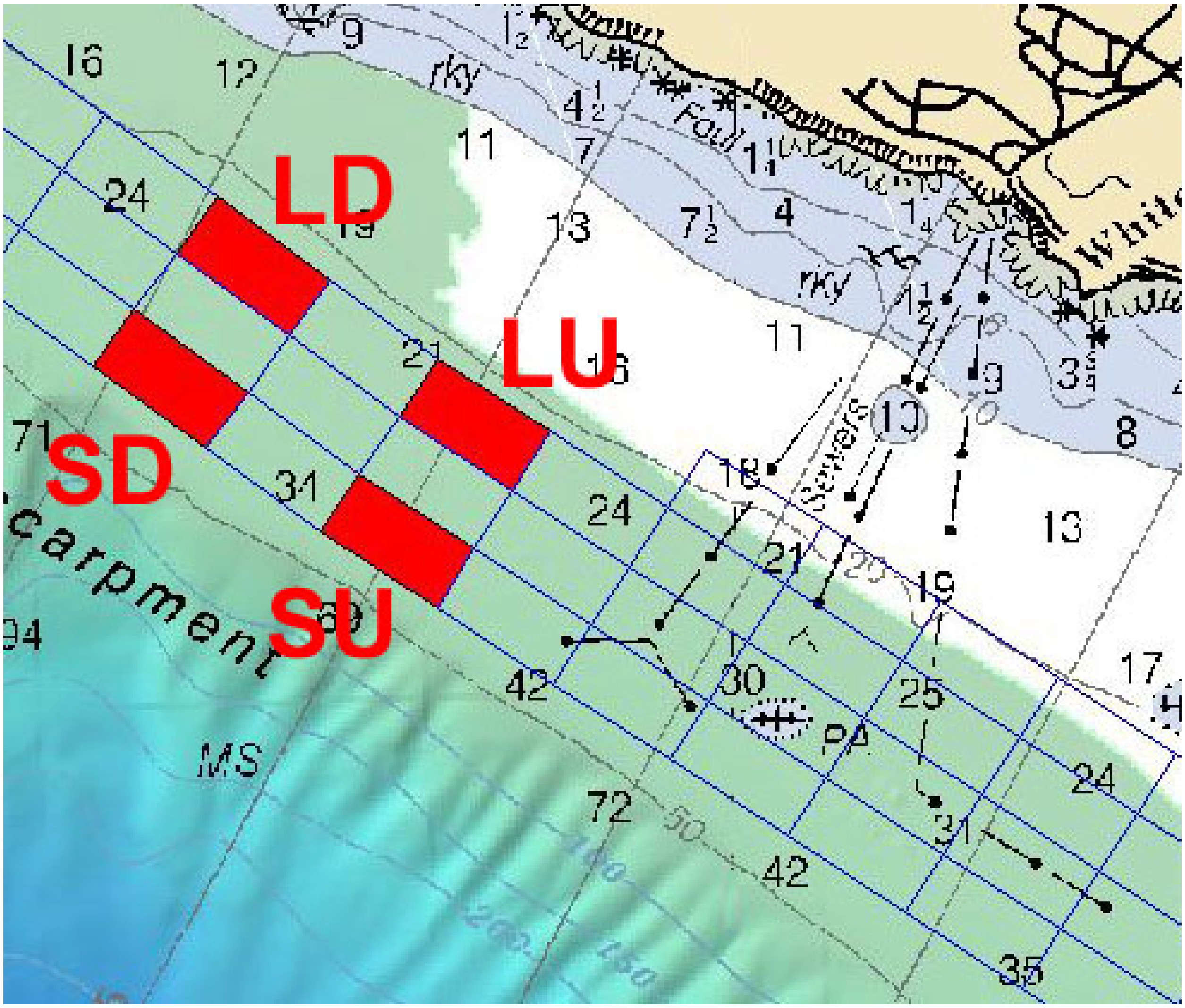

Figure 1. Map showing placement cell locations and locations of pilot cells.